ENERGY EFFICIENCY PUMPS AND FANS

Energy Conservation Opportunities

MA OTA

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Energy Efficiency Pumps and Fans

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Energy Efficiency
Pumps

- Involve all levels of employees in suggesting pump efficiency improvements
- Conduct an In-Plant Pumping System Survey
- Maintain Pumping Systems Effectively
- Correct inefficiencies in the system

Energy Efficiency Pumps

Involve all Levels of Employees

Management

Supervisors

Operators

PUMPING SYSTEM SURVEY

The Department of Energy provides a software tool to assess the efficiency of pumping systems called PSAT.

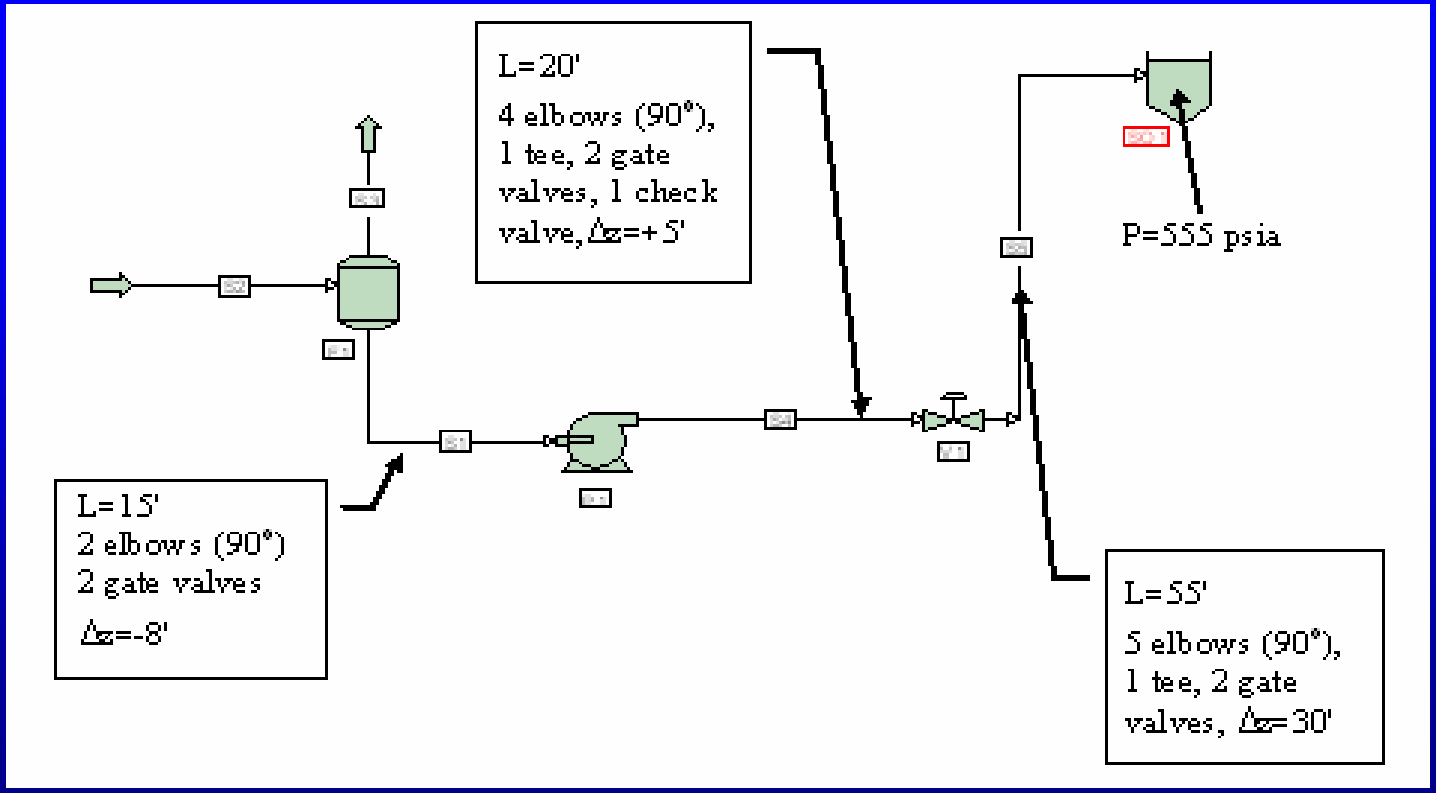
- The DOE has obtained savings using PSAT in the following industries however pumps are common to all industries.

Industry # of Assessments	Average Energy savings Million BTU/year	Average Annual savings
• Aluminum (2)	1,882,500	$74,000
• Chemicals (1)	1,601,200	$106,000
• Forest Products	4,717,400	$186,500
Mining(7)	9,419,100	$410,700
• Petroleum (2)	1,150,000	$46,000
• Steel (2)	5,787,500	$231,500

Conduct an In-Plant Pumping System Survey, this includes:

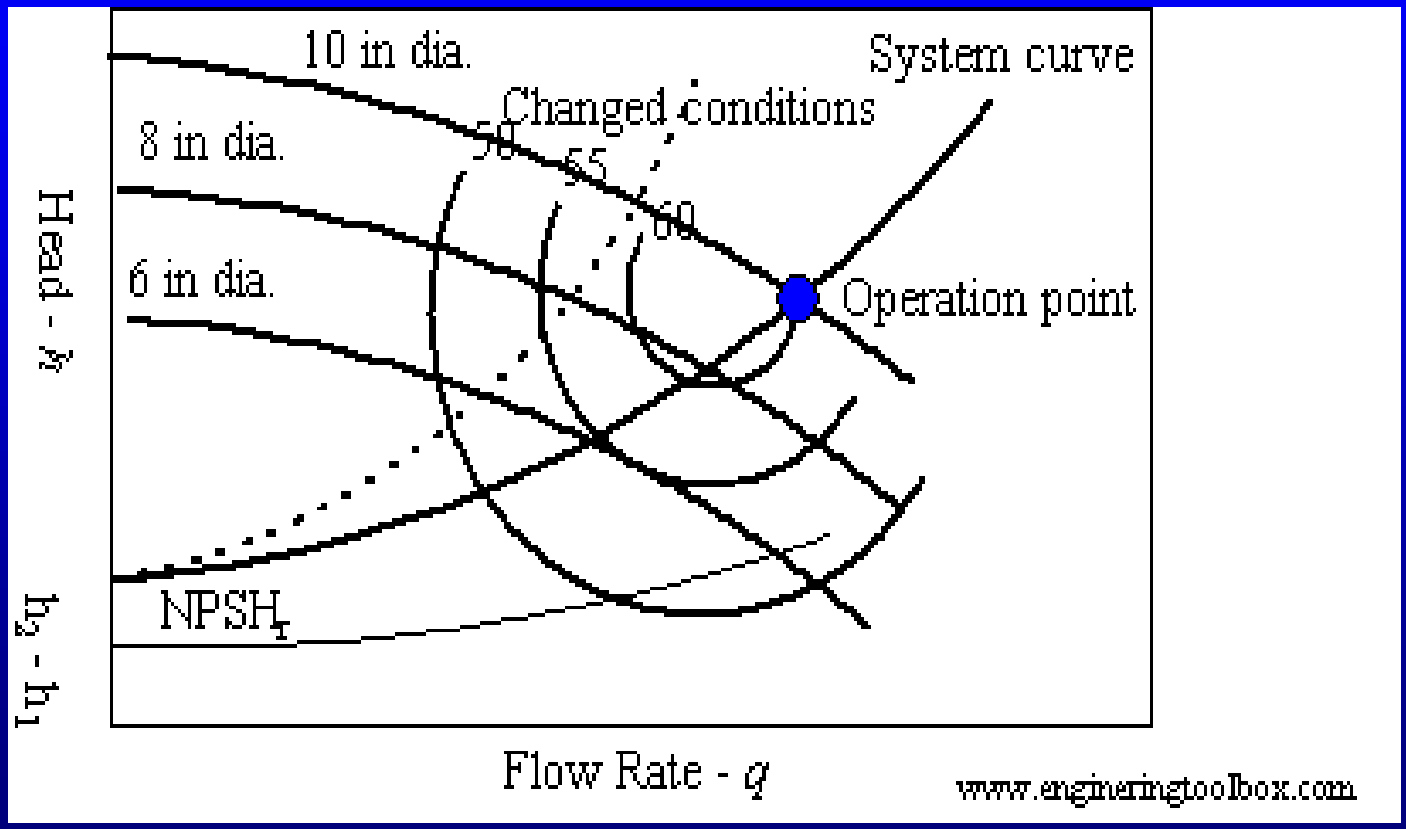
- Develop a system curve by measuring pressure at selected points in the pipe at different flows.
- The selected points include suction and discharge pressures.
- Obtain the performance curve of the pump from the manufacturer if you do not already have it.

SCHEMATIC OF A PUMPING SYSTEM



Energy Efficiency Pumps

- In-Plant Pumping System Survey, cont'd



In-Plant Pumping System Survey, cont'd

- Find out where the system curve intersects the performance curve.
- This point should be within 20% of the pumps best efficiency point (BEP).
- Average operating flow – check control valve opening.

Energy Efficiency Pumps

MAINTAIN PUMPING SYSTEMS EFFECTIVELY

- **Packing.**
- **Mechanical Seals.**
- **Bearings.**

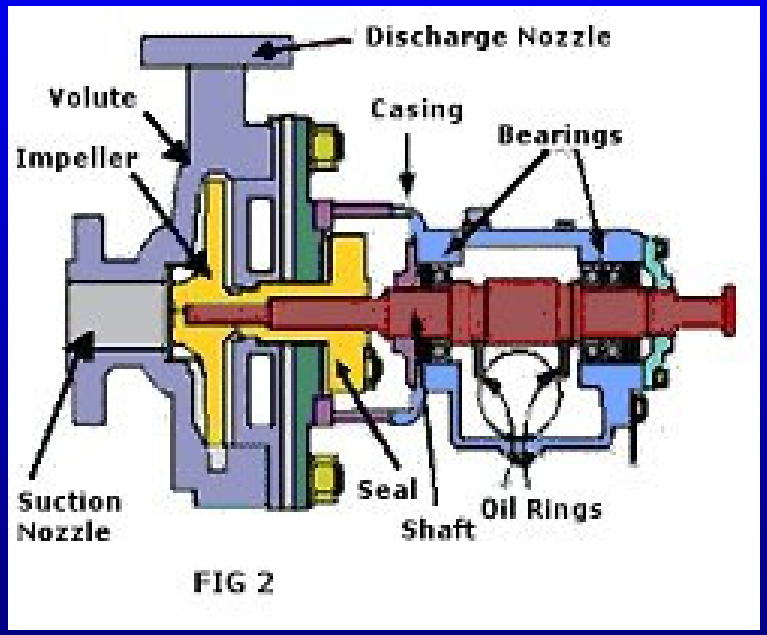


FIG 2

OTA

MAINTAIN PUMPING SYSTEMS EFFECTIVELY, cont'd

- **Motor/Pump Alignment.**
- **Motor Condition.**

CORRECT INEFFICIENCIES IN THE SYSTEM

Conduct a detailed review of your plants pumping system if:

- The imbalance between the designed system requirements and the actual (measured) discharged head and flow exceeds 20%

CORRECT INEFFICIENCIES IN THE SYSTEM

A pump may be incorrectly sized if:

- it operates under throttled conditions
- has a high bypass flow rate
- has a flow rate that varies more than 30% from its best efficiency point (BEP).

CORRECT INEFFICIENCIES IN THE SYSTEM

Efficient solutions include:

- using multiple pumps by adding smaller auxiliary (pony) pumps
- trimming impellers
- adding a variable speed drive.

CORRECT INEFFICIENCIES IN THE SYSTEM

Reduce pumping costs through optimum pipe sizing -

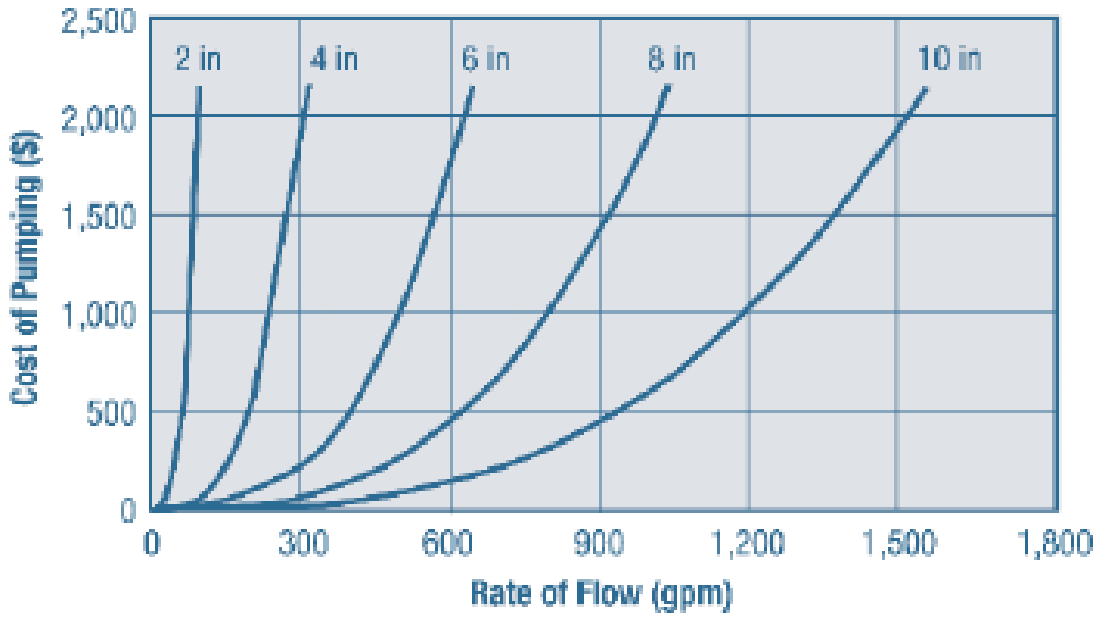
- Frictional losses depend on:
  - Flow in pipe
  - Overall pipe length
  - Surface roughness
  - Fluid viscosity
  - Pipe diameter
- Keeping all other variables the same, the energy required to pump will decrease with increasing pipe diameter

Energy Efficiency

CORRECT INEFFICIENCIES IN THE SYSTEM

- Correct Imbalanced Pumping Systems

Figure 1. Annual water pumping cost for 1,000 feet of pipe of different sizes



Based on 1,000 ft. for clean iron and steel pipes (schedule 40) for pumping 70°F water. Electricity rate—0.05 $/kWh and 8,760 operating hours annually. Combined pump and motor efficiency—70%.

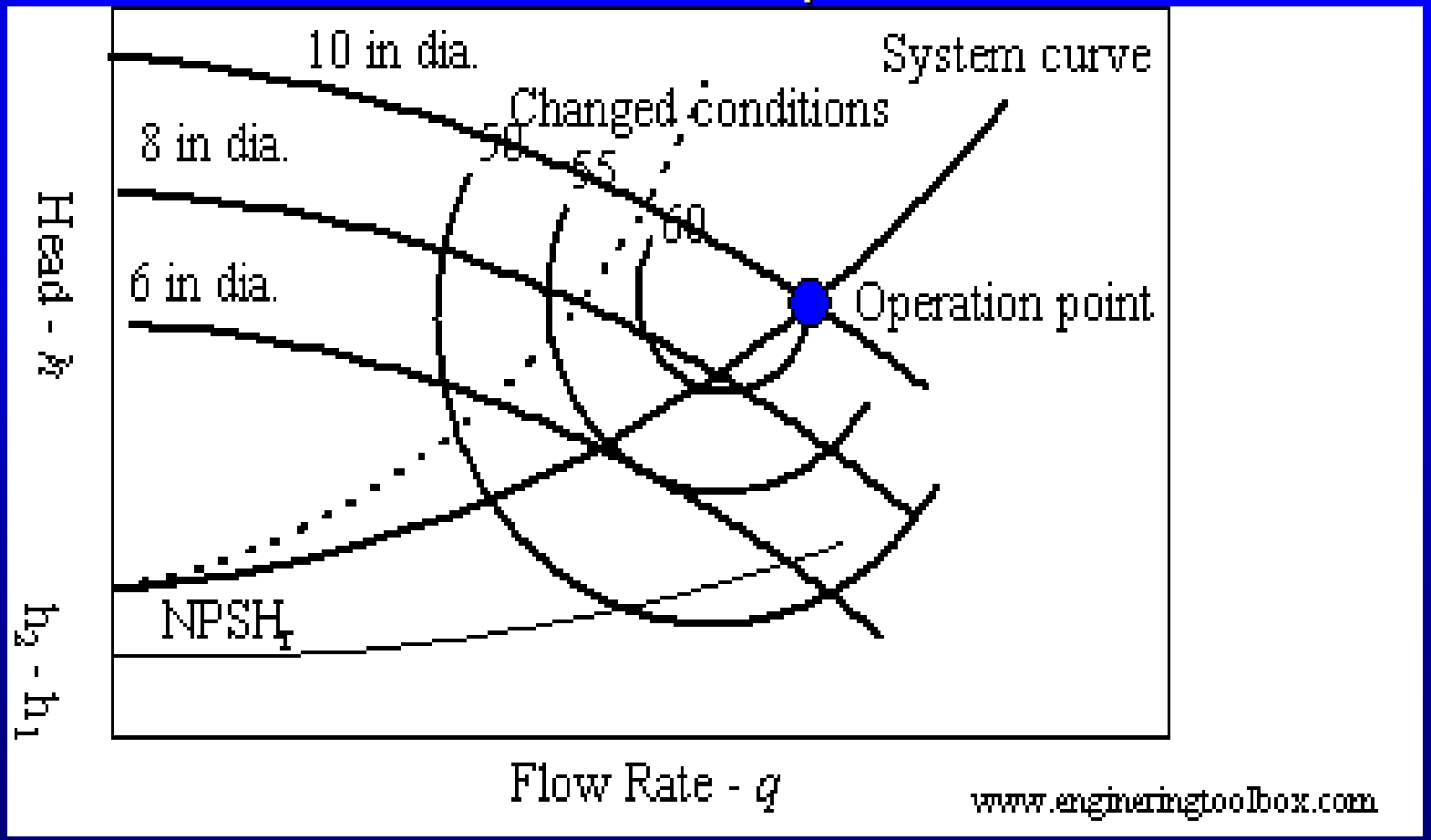
CORRECT INEFFICIENCIES IN THE SYSTEM

Trim or replace impellers

- Trimming involves machining the impeller to reduce its diameter.
- Many pump manufacturers provide performance curves at different impeller sizes.
- Smaller impellers require less brake horsepower and therefore energy.

CORRECT INEFFICIENCIES IN THE SYSTEM

Different Impeller sizes



CORRECT INEFFICIENCIES IN THE SYSTEM

Variable Speed Drives:

- Will respond to the system flow requirements and therefore remove the problem of using more power than the system demands.

CORRECT INEFFICIENCIES IN THE SYSTEM

VARIABLE SPEED DRIVE

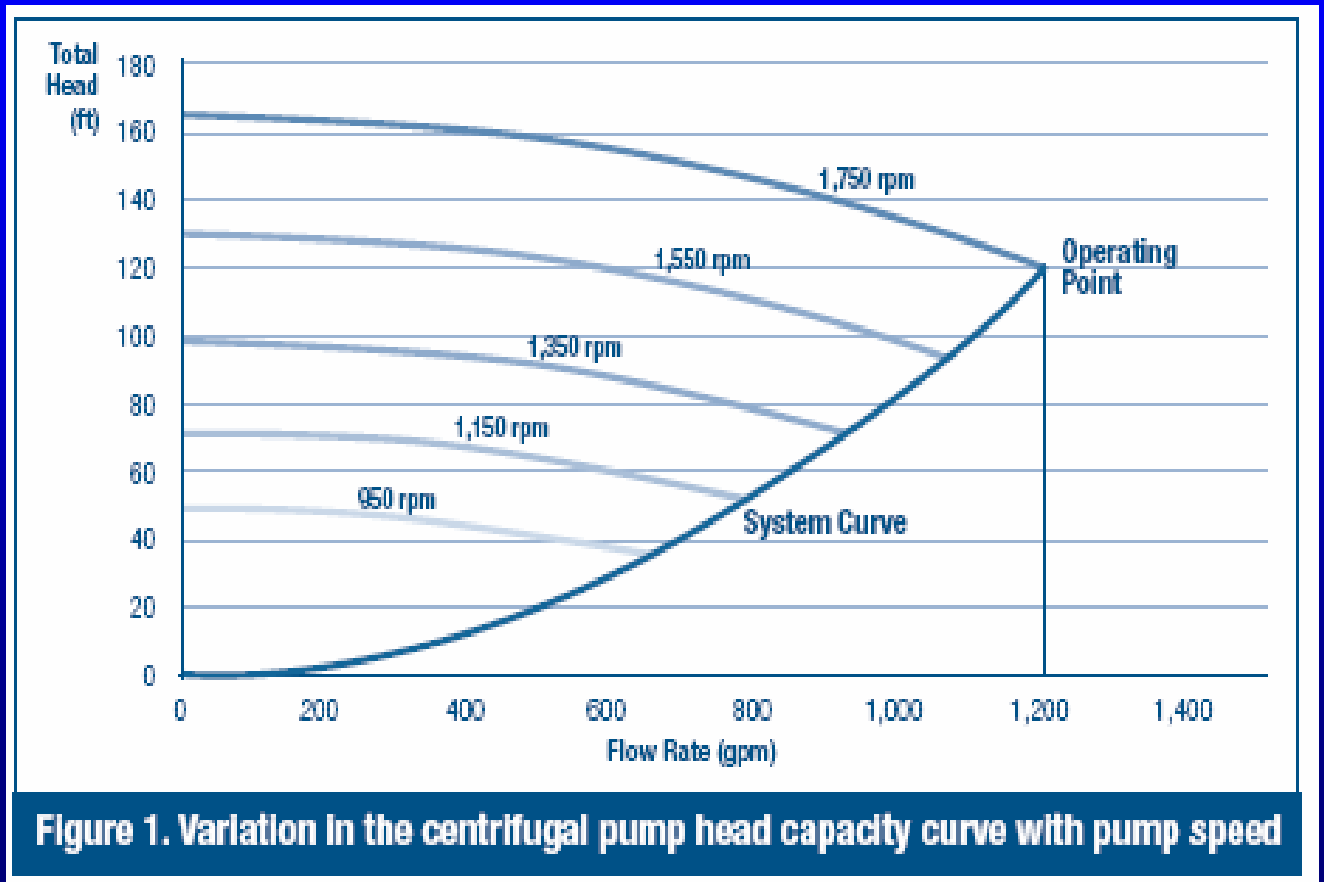


Figure 1. Variation in the centrifugal pump head capacity curve with pump speed

Energy Efficiency - Fans

The Fan System Assessment Tool (FSAT).

- A DOE software tool to assess fan system efficiency
- Quantifies energy consumption and savings opportunities
- Simple and Quick - requires only basic information
- Calculates the amount of energy used; determines system efficiency and savings potential.

Energy Efficiency - Fans

- Perform periodic maintenance
- Ensure proper fan sizing
- Design with inlet and outlet ducts as straight as possible

Energy Efficiency - Fans

- Consider Variable Frequency Drives (VFDs) to improve fan operating efficiency over a wide range of operating conditions
- Maintain proper belt tension and alignment
- Combine fans in parallel or in series where applicable to increase efficiency and reduce costs.

Common Maintenance Tasks Include:

- **Periodic inspection of all system units**
- **Bearing lubrication and replacement**
- **Belt tightening and replacement**
- **Motor repair and replacement**
- **Fan and system cleaning**
- **Check ductwork leaks**

Ensure Proper Fan Sizing

- **Compare pressure required by the end use to the pressure generated by the fan. If it is oversized it will generate more total pressure for the same airflow than a correctly sized fan.**

FAN AND SYSTEM CURVES

- Generate a system curve to determine power consumption.
- Obtain the fan curve from the manufacturer.
- If the system curve intersects the fan curve at a point that is not near the best efficiency point (BEP), the fan is oversized.

Example of Fan System Components

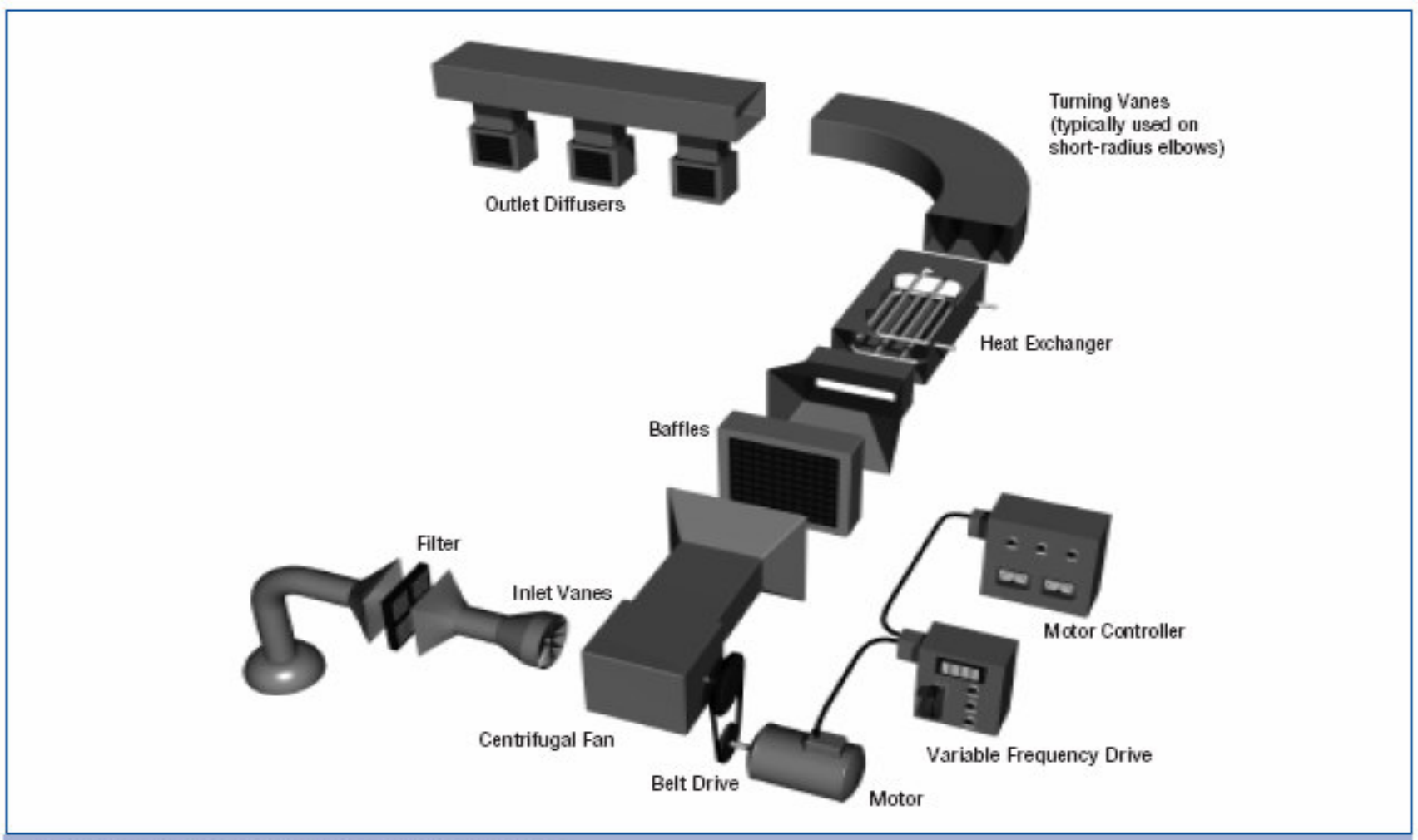


Figure 1-3. Example Fan System Components

VARIABLE FREQUENCY DRIVES

- improve fan operating efficiency over a wide range of operating conditions.
- provide an effective and easy method of controlling airflow.
- are able to retrofit to existing motors.
- eliminate fouling problems associated with mechanical control devices.
- One disadvantage is a low rotational speed risks unstable operation.

Fan Performance and System Operating Point

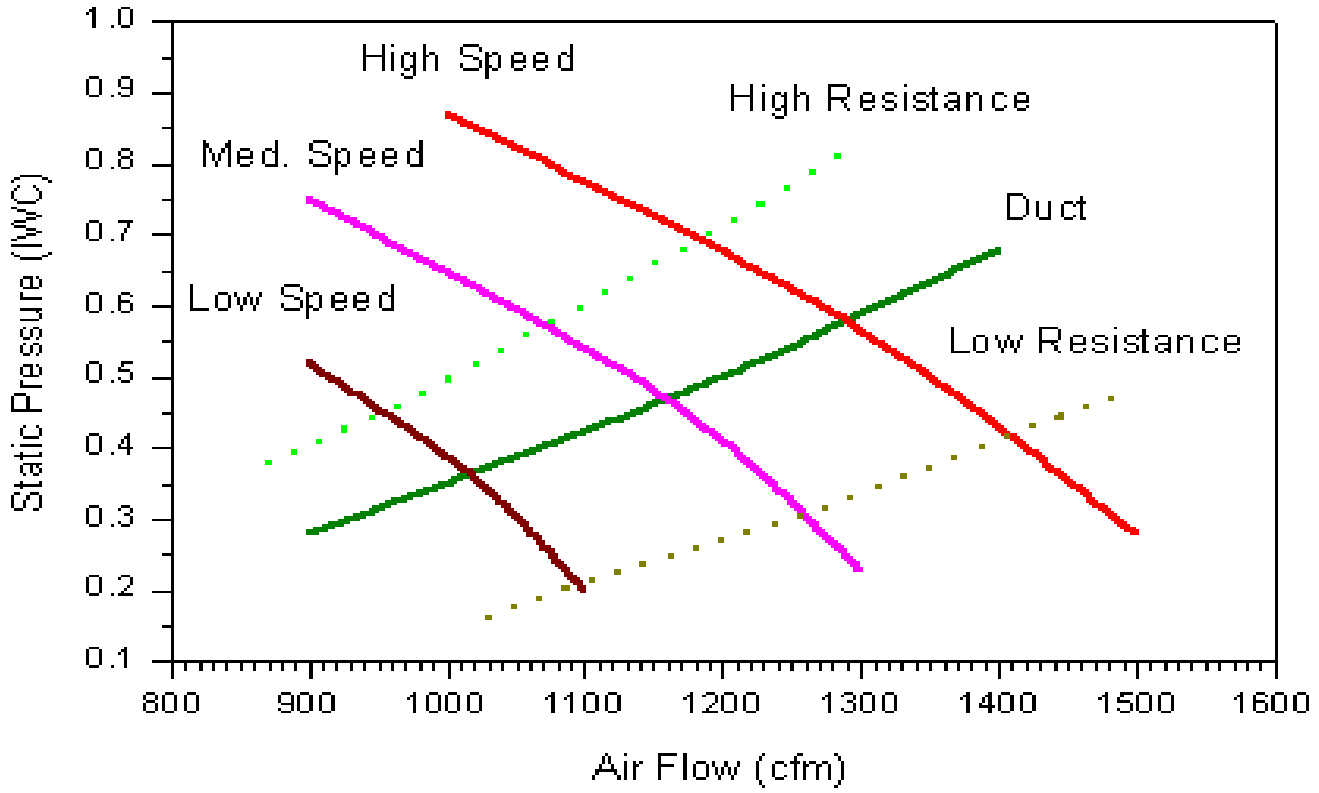


Figure 1. Influence of fan performance and duct flow resistance on system operating point.

SUMMARY

- Energy Conservation for Pumps and Fans must involve all levels of employees.
- Conduct an In-Plant Pump or Fan System Survey
- Correct inefficiencies in the system
- Institute A Preventative Maintenance Program
- There are state and federal agencies that conduct free facility audits to identify areas where energy can be conserved.
- For more information contact OTA at: www.mass.gov/envir/ota or at 617-626-1060

References:

- DOE Pumping Systems TIP Sheets
- http://www1.eere.energy.gov/industry/bestpractices/tip_sheets_pumps.html

- DOE and Hydraulic Institute: Improving Fan System Performance: A Sourcebook for Industry